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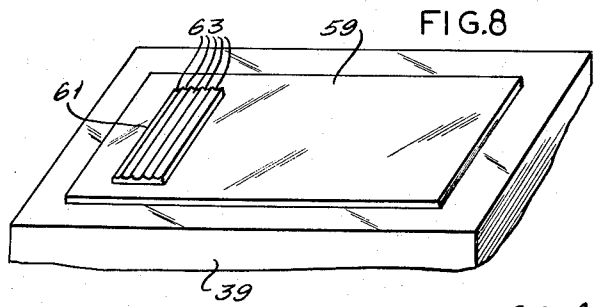
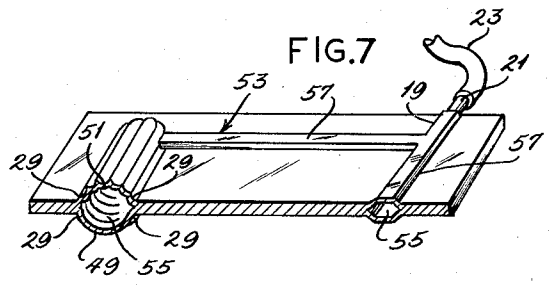
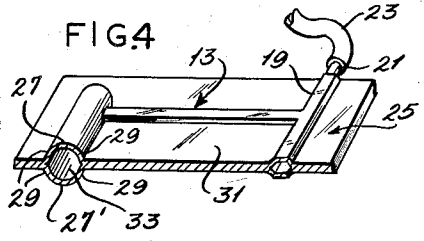
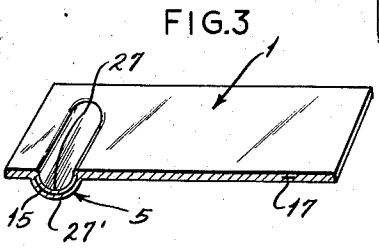
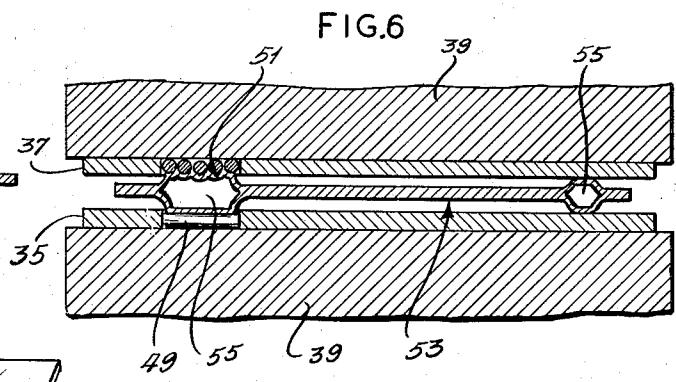
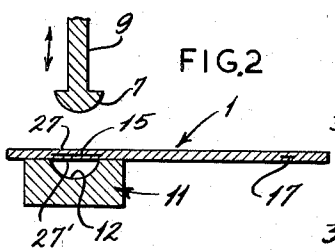
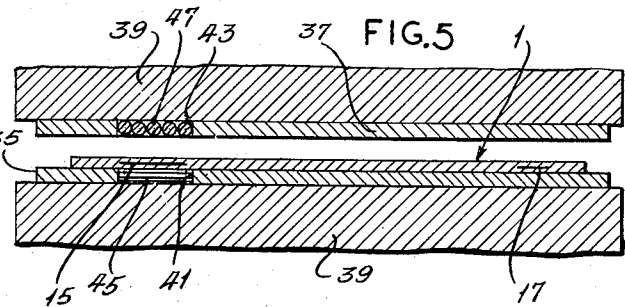
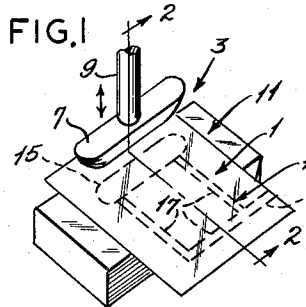
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2,982,013

FABRICATION OF HOLLOW ARTICLES

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FIG. 1



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FABRICATION OF HOLLOW ARTICLES

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2 Claims. (Cl. 29—157.3)

This invention relates to the fabrication of hollow articles and more particularly to forming the hollows in such articles.

In the process for fabricating hollow expanded sheet metal articles described in U.S. Patent No. 2,690,002, granted September 28, 1954, a pattern of weld-inhibiting material is applied to a clean surface of a sheet of metal and a clean surface of a second sheet of metal is superimposed on the first surface to which the pattern has been applied. The superimposed sheets are then tacked together as by spot welding to prevent relative slippage and the sheets are then welded together in their adjacent areas not separated by the weld-inhibiting pattern, in any appropriate manner as by hot rolling, to form a blank. During the rolling operation the sheets are elongated in the direction of rolling and it is therefore necessary to foreshorten the pattern of weld-inhibiting material in the intended direction of rolling. An opening is then formed into the unjoined portion of the blank defined by the weld-inhibiting pattern and a fluid pressure is injected therein to permanently distend the metal of the blank in the area of the weld-inhibiting material and form a hollow article. The pattern of weld-inhibiting material may assume any desired configuration. For example, the pattern may be such as to define a refrigerator evaporator fluid conveying circuit after expansion of the blank. This process of forming hollow articles is fully described in the aforementioned patent.

In expanding the unjoined portion of the blank defined by the pattern of weld-inhibiting material to form a hollow article, the metal which forms the wall of the hollow will neck-down in the area adjacent the solid portion of the article. In other words, prior to expansion of the blank the metal is of substantially the same thickness throughout the entire blank. Half of this thickness forms each wall defining the unjoined portion of the blank. Upon expansion of the unjoined portion the metal which distends outwardly the farthest will normally be of approximately the same thickness as the wall of the unjoined portion of the blank prior to expansion. However, in the area where the wall of the hollow portion of the blank joins the solid or web portion of the expanded article a reduction in the thickness of the wall will occur caused by stretching of the metal in forming the hollow. Because of this necking-down, upon application of an excessive pressure within the expanded portion of the hollow article, failure through rupture of the distended walls will almost invariably occur at the juncture of the web or solid portion of the blank and the wall of the hollow portion. The necking-down effect is most noticeable and objectionable in large hollow portions, such as an accumulator in a heat exchange panel.

The expansion of a blank to form a hollow article normally results in the web or solid portion of the article being drawn in toward the hollow portion. This normally occurs because the web is of insufficient strength to adequately resist the distention of the walls of the hollow portion. Such drawing in results in distortion of

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the desired hollows which is particularly noticeable when the hollows of the article include elongated straight tubes because of the curvature imparted to the tubes. The drawing in of the blank also tends to result in warping the finished article.

In order to overcome these objections, the metal of the blank which is to form the walls of the hollow in the finished article may be stretched in a controlled manner prior to expansion by the fluid pressure. Such stretching may be accomplished for example, by die stamping the portion of the blank to be expanded or by initially expanding the unjoined portion of the blank to a lesser degree than that ultimately desired and concurrently stretching the portion of the walls of the hollow which are normally of greatest thickness.

It is therefore an object of this invention to provide an improved hollow article.

Another object of this invention is to reduce the tendency of the walls of a hollow expanded article to neck down at the juncture of the wall and the adjacent solid portion of the article.

Another object of this invention is to fabricate an expanded hollow article while reducing the tendency of the article to draw in toward the hollow, as the hollow is expanded.

Another object of this invention is to reduce the tendency of a hollow expanded article to warp during expansion of the hollow in the article.

Additional objects and advantages will be apparent from the following description and drawings in which:

Figure 1 illustrates an embodiment of the invention showing a schematic perspective view of a blank positioned in a stamping die;

Figure 2 is a sectional view taken on the line 2—2 in Figure 1;

Figure 3 is a partial sectional view of the blank shown in Figures 1 and 2 after it has been die stamped;

Figure 4 is a partial sectional view showing the blank in Figure 3 after it has been expanded to form a hollow article;

Figure 5 illustrates another embodiment of the invention showing a schematic sectional view of a blank of the type shown in Figure 1, but positioned between a pair of rigid restraining pads having a special indenting portion;

Figure 6 is a schematic sectional view similar to Figure 5, but showing the blank after it has been expanded to form a hollow article;

Figure 7 is a longitudinal sectional view of the blank shown in Figure 6 after another expansion has been effected;

Figure 8 illustrates another embodiment of one of the rigid restraining platens illustrated in Figures 5 and 6.

Referring to Figures 1—4, a blank 1 is positioned in stamping die 3. This die may be of any appropriate type which will form a cupped portion 5 as shown in Figure 3. In the illustrated embodiment the male die member 7 is secured to a reciprocating plunger 9. The female die member 11 has a cut-out cupped portion 12 and is fixed.

The blank may be fabricated in any appropriate manner as by the method mentioned in the aforementioned patent, No. 2,690,002, and has an unjoined interior portion 13 indicated by the dotted lines in Figure 1. This unjoined portion comprises a relatively large area 15, a plurality of smaller unjoined areas 17 adjacent thereto, and an unjoined portion 19 which connects a portion of the area 17 and an edge of the blank.

As is most clearly illustrated in Figure 2, the relatively larger interior portion 15 of the blank 1 is positioned adjacent the cupped portion 12 of the die block 11 whereupon the male die member 7 is impacted against the

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blank, which causes the stamped portion 5 of the blank to assume the configuration of the die cup 12.

In order to expand the unjoined portion 13 of the blank to form the expanded hollow article shown in Figure 4, the unjoined inlet 19 is separated, in any appropriate manner, as by driving a punch therein and a fluid pressure supply nozzle 21 is sealed in this opening. The nozzle 21 may be connected with a source of fluid pressure in any appropriate manner as by a hose 23. As a fluid pressure is injected into the blank 1 the walls forming the unjoined portion of the blank distend outwardly providing the expanded hollow portion in the finished hollow article 25. The fluid pressure causes the upper concave wall 27 of the cupped portion 5 of the blank 1 shown in Figure 3 to reverse its concave configuration and form the convex outer surface as shown in Figure 4.

By stamping the walls 27 and 27' of the relatively large unjoined portion 15 of the blank, the metal is substantially evenly stretched throughout the entirety of the walls so that upon introduction of the fluid pressure the severe necking-down which would normally occur at the juncture 29 between the walls and the solid web portion 31 of the blank is substantially reduced and it is therefore possible to form much larger and stronger hollows 33 by evenly stretching the metal prior to expansion by a fluid pressure.

Figures 5-7 illustrate another embodiment of the invention wherein the blank 1 is positioned between a pair of rigid restraining pads 35 and 37. These restraining pads are fixed to the relatively movable jaws 39 of a press. As illustrated in Figure 5, the rigid restraining pads 35 and 37 are each provided with cut-out portions 41 and 43 respectively. The relatively large unjoined area 15 of the blank is aligned with these cut-out portions in any conventional manner such as by cooperating index marks on the lower pad 35 and the blank 1. The lower cut-out portion 41 has welded therein parallel rods 45 and the cut-out portion 43 of the upper pad 37 has similar parallel rods 47 welded therein, but transverse to the rods 45. By having the rods running in different directions the stress in the expanded panel is more nearly equalized. However, if desired the rods in both cut-out portions may run in the same direction. When an elongated area is to be expanded, it has generally been found that rods running parallel to the longitudinal axis of the area will facilitate better stretching of the metal and less necking-down in the area 29.

A fluid pressure is now injected through the inlet 19 into the unjoined portion 13 of the blank 1 expanding the unjoined portion into firm engagement with the rigid restraining pads 35 and 37 and the rods 45 and 47. In expanding the blank in this manner, a fluid pressure much above the rupture pressure of the blank when unrestrained between the pads is desirable since a greater volume is provided in the expanded portion of the panel and the walls 27 and 27' of the relatively large unjoined area 15 are more firmly impressed into engagement with the rods 45 and 47 thereby providing a corrugated like surface on the walls 49 and 51 of the expanded article 53. The fluid within the expanded hollow portion 55 of the panel is now released, the jaws 39 are spaced apart, and the hollow article 53 is removed. At this point, the outer surfaces of the distended walls of the expanded article are substantially flat as indicated by walls 57 in Figure 7. A fluid pressure is again injected through the nozzle into the previously expanded portion 55. During this stage of the expansion of the article the fluid pressure is much lower than that exerted in the article during the initial expansion stage illustrated in Figure 6. As the panel is now unrestrained by the pads 35 and 37, the pressure must be reduced so that the blank will not rupture. The pressure must, however, be high enough to outwardly distend the walls 49 and 51 of the relatively large expanded area. During expansion

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of this portion of the panel, the corrugations tend to open out in an accordion-like manner so that sufficient metal is provided in the outer portion of the expanded panel and necking-down in the area 29 is greatly retarded over that which would occur if the blank 1 were expanded by merely injecting a fluid pressure into the unjoined portion 13.

In both of the illustrated and described embodiments shown in Figures 4 and 7, the inflation steps may be altered in various manners. For example, the blank of Figure 3 or the hollow article of Figure 6 may be expanded between resilient restraining pads either spaced from or engaging the surface of the blank, or hollow article respectively. Alternately, the blank or hollow article shown in Figures 3 and 6, respectively, may be restrained between rigid pads having cut-out portions to permit free distention of the cup 5, or walls 49 and 51, respectively. Instead of using merely cut-out portions in such restraining pads, the pads may be provided with cut-out die portions to further restrain and shape the large expanded areas. In other words, following stamping of the cup 5 as illustrated in Figure 3, or forming the corrugations on the partially expanded article as indicated in Figure 6, the panel may be expanded in any suitable manner.

Figure 8 illustrates another embodiment of a restraining pad. Only the lower assembly of a pad and press jaw is shown in this view and the upper assembly is similar to the lower assembly. A rigid pad 59 is fixed on the jaw 39 of the press. Positioned on the blank engaging surface of the pad 59 is a rigid block 61. The blank engaging surface of the block is provided with a plurality of parallel grooves 63 forming a corrugated like surface. The block should be as thin as possible while retaining adequate strength, to permit maximum possible outward distention of the walls 49 and 54 during the initial expansion step illustrated in Figure 6. The members 35, 37, 59, and 61 are preferably fabricated out of a metal stronger and tougher than the blank 1.

This invention is directed primarily to expanded hollow metal panels fabricated in the manner of the aforementioned patent. However, it is equally applicable to the expansion of blanks fabricated by other methods as well as to blanks fabricated of other materials such as plastics or combination metal and plastic blanks.

Although this invention has been described with reference to certain embodiments, materials, and details, various modifications will be apparent to one skilled in the art, and the invention is therefore not to be limited to such embodiments, materials, and details except as set forth in the appended claims.

I claim:

1. A method of increasing the volume obtainable in a hollow article by inflation of a sheet of ductile metal having parallel upper and lower surfaces and an unjoined interior portion contained within said sheet, said unjoined portion being defined within complementary portions of said sheet parallel to said surfaces, said method comprising stretching said complementary portions together in the same direction into a cup-shaped configuration extending out of the plane of one of said surfaces with said direction being transverse said plane, and subsequently injecting sufficient fluid pressure into said unjoined portion to inflate said unjoined portion and separate said complementary portions away from each other.

2. A method of increasing the volume obtainable in a hollow article by inflation of a sheet of ductile metal having parallel upper and lower surfaces and an unjoined interior portion contained within said sheet, said unjoined portion being defined within complementary portions of said sheet parallel to said surfaces, said method comprising stretching said complementary portions together in the same direction so as to form a cup-shaped configuration extending out of the plane of one of said

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surfaces with said direction being transverse said plane, and subsequently injecting at least sufficient fluid pressure into said unjoined portion to deform one of said complementary portions forming the inner wall of said cup-shaped configuration outwardly to extend beyond the other surface of said sheet out of the plane of said other surface.

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